(12) UK Patent Application (19) GB (11) 2 370 368 (13) A

(43) Date of A Publication 26.06.2002

(21) Application No 0031124.1

(22) Date of Filing 20.12.2000

(71) Applicant(s)
Nokia Corporation
(Incorporated in Finland)
Keilalahdentie 4, FIN-02150 Espoo, Finland

(72) Inventor(s)
Steven Charles Doe

(74) Agent and/or Address for Service
Venner Shipley & Co
20 Little Britain, LONDON, EC1A 7DH,
United Kingdom

(51) INT CL^7
G02F 1/1335

(52) UK CL (Edition T)
G2F FSX F23E F25F F25P2

(56) Documents Cited

GB 2119110 A	**GB 2075211 A**
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(58) Field of Search
UK CL (Edition S) **G2F FSX**
INT CL^7 **G02F 1/1335**
Online: WPI, EPODOC, PAJ

(54) Abstract Title
Electronic display

(57) An electronic display comprising an active layer 2 spaced from a polarising filter 7, 8 by a supporting layer 11a, 11b which provides a common substrate for both the polarising filter 7, 8 and the active layer 2. Preferably, the supporting layers 11a, 11b are constructed from plastic film. The electronic display may be used in a telecommunications device, such as a mobile telephone.

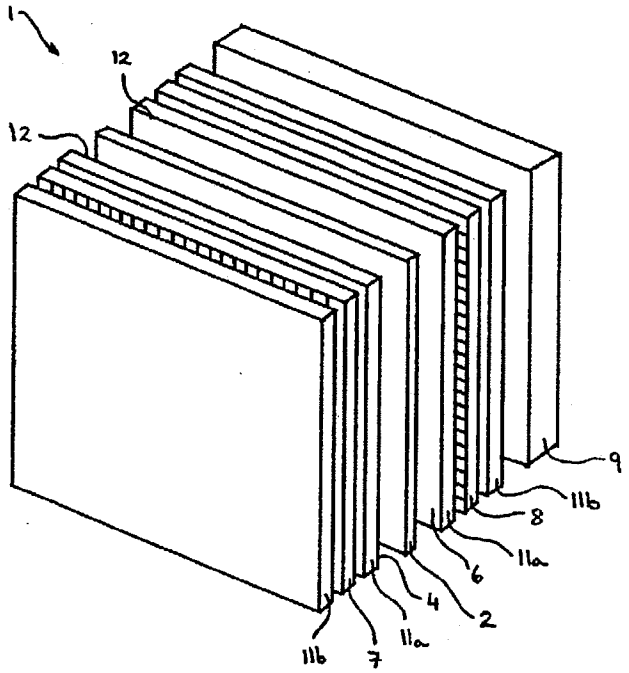

FIGURE 2

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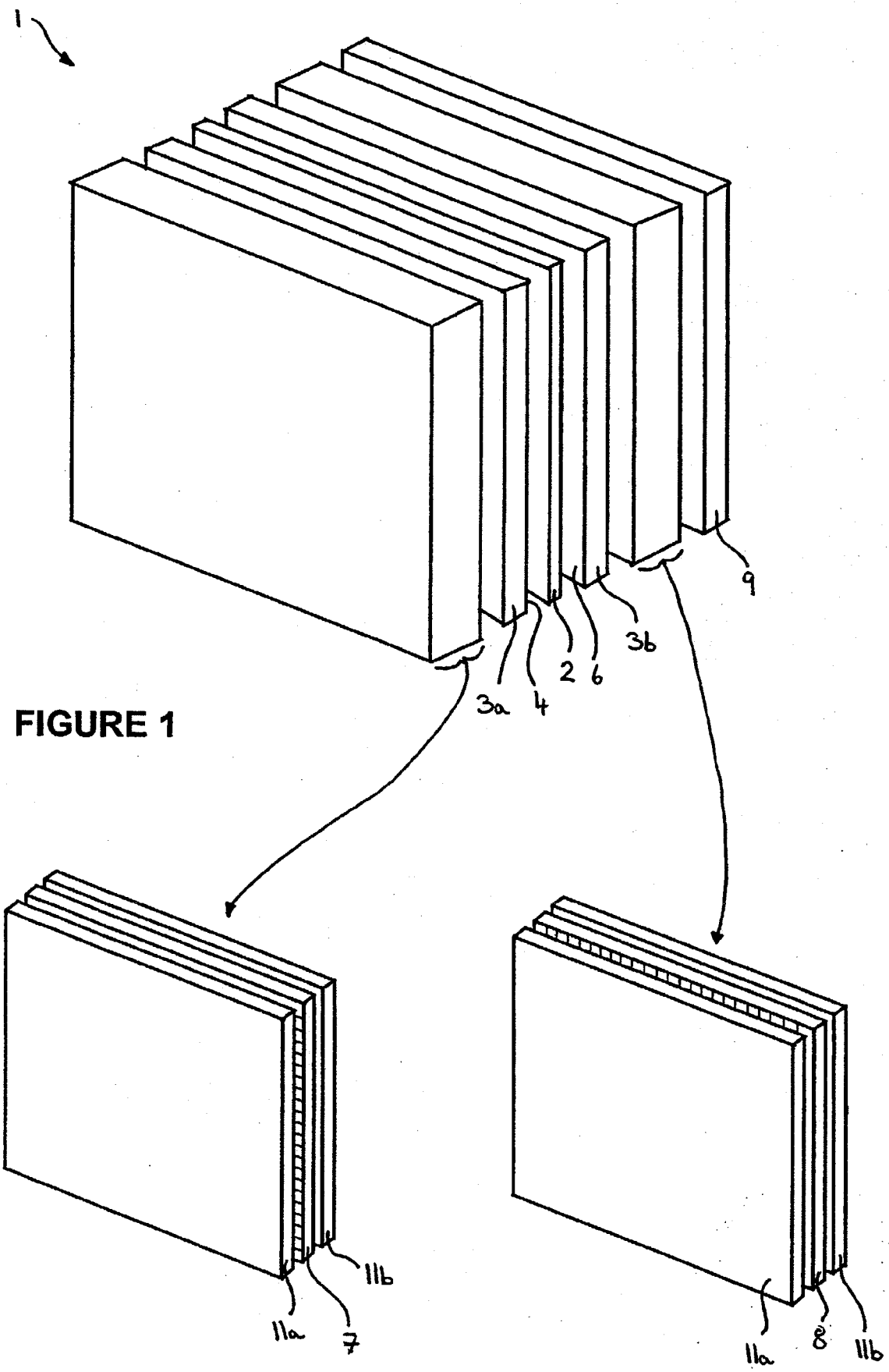

FIGURE 1

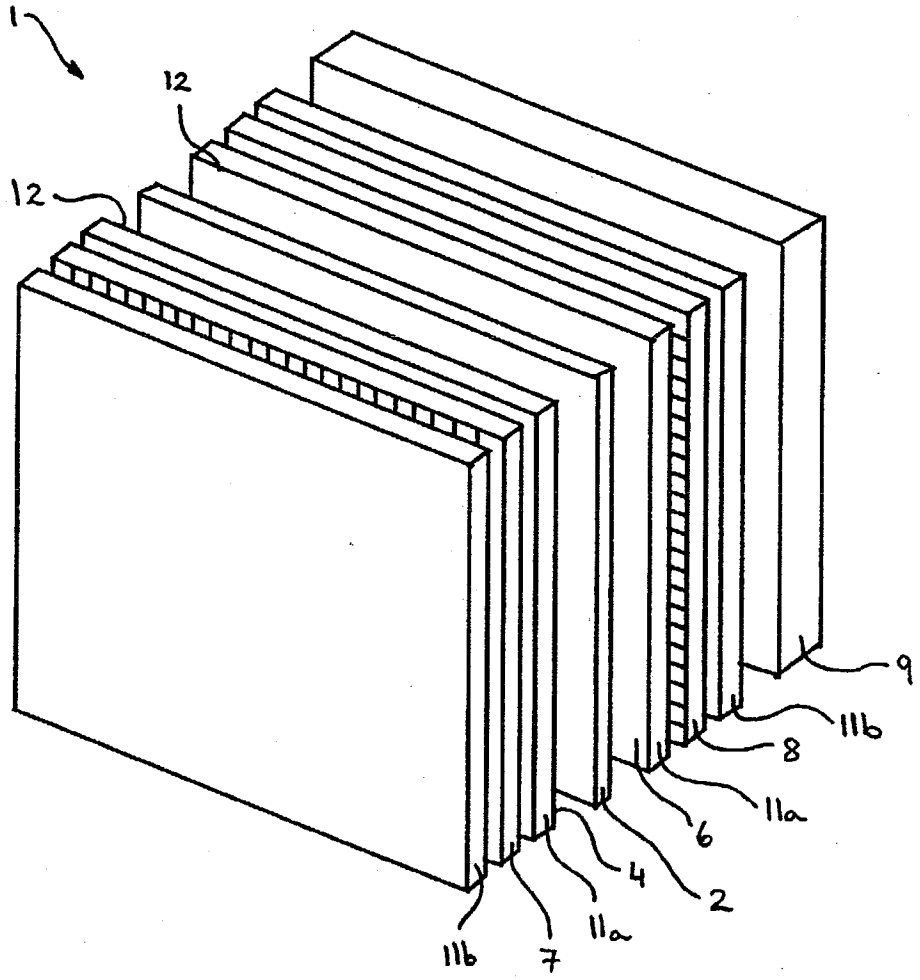

FIGURE 2

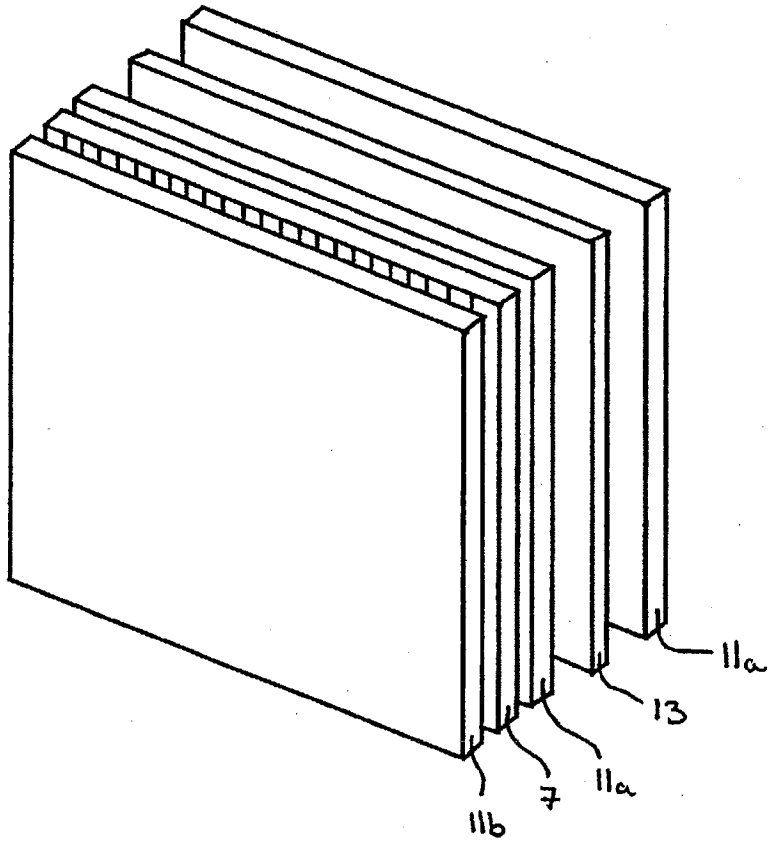

FIGURE 3

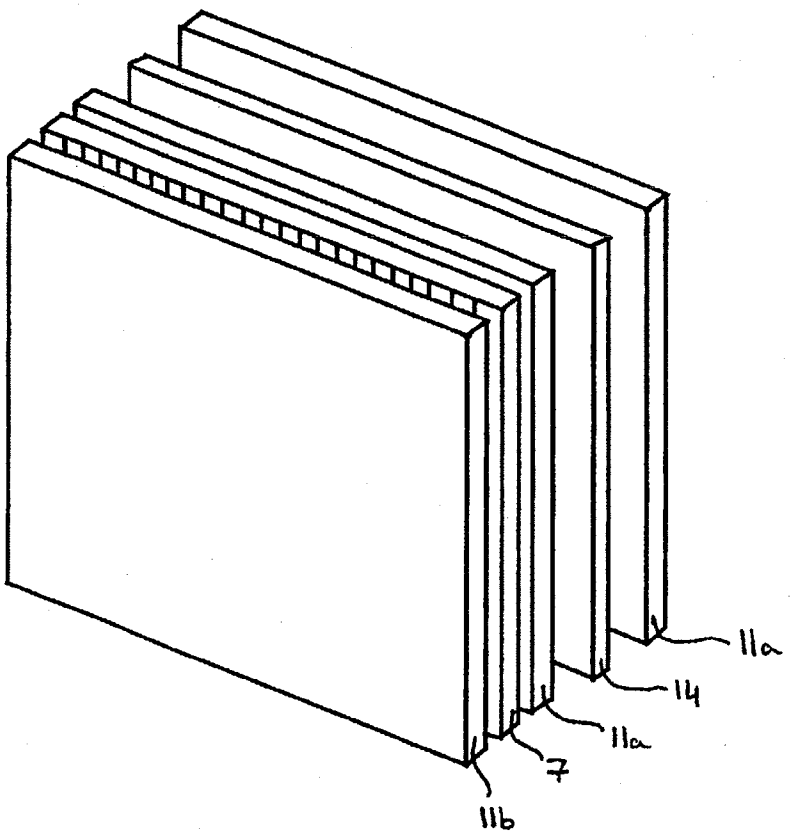

FIGURE 4

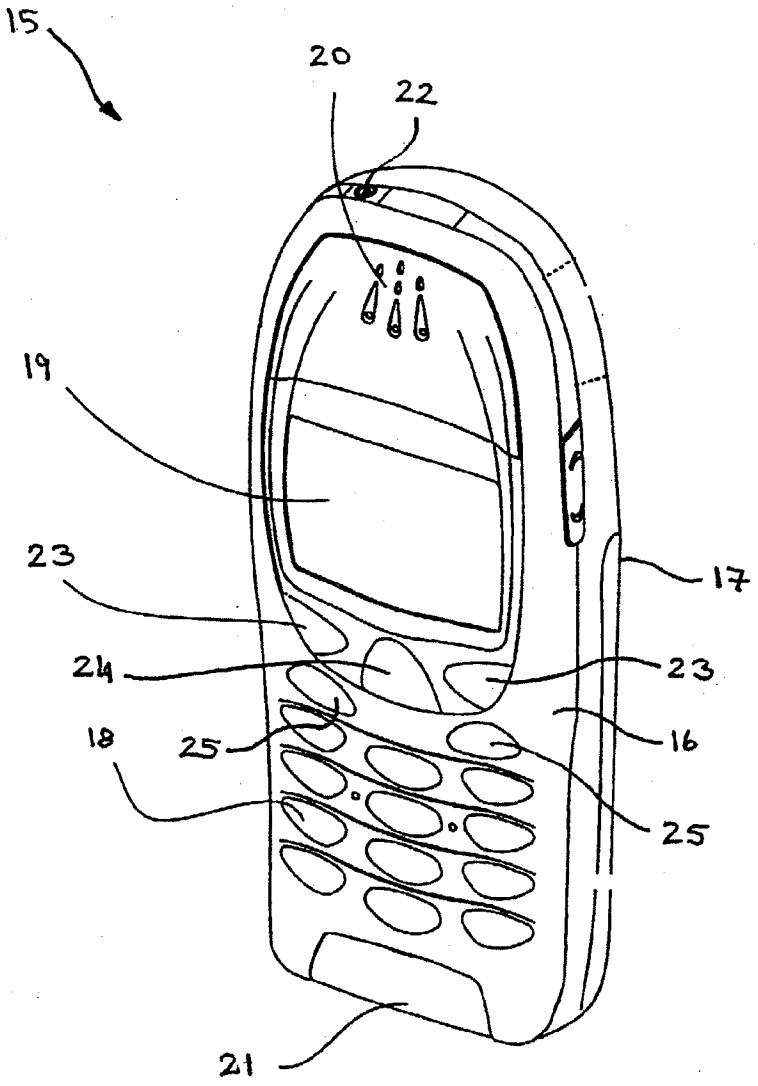

FIGURE 5

Electronic Display

Description

The present invention relates to electronic displays such as liquid crystal displays (LCD's) and more specifically to thin film LCD's made from plastic. Other types of electronic display include light emitting polymer (LEP) displays and organic light emitting diode (LED) displays. The invention also relates to a mobile telecommunications device, such as a mobile telephone, incorporating an electronic display according to the invention.

LCDs are well known and generally comprise a digital or alphanumeric display consisting of liquid crystal material sealed between two substrate sheets of plastic or glass. A thin transparent film of conductive material such as a transparent metal oxide film is applied to the surface of each substrate facing the liquid crystal material and the conductive film on one sheet is etched into character forming segments, each having electrical leads extending towards the edge of the sheet for connection to driving circuitry which controls the voltage applied to various areas of the display, and a power supply such as a battery. A polarising filter sandwiched between two transparent supporting layers is also disposed on the outer surface of each substrate sheet with their planes of polarisation oriented at right angles to each other.

The most common LCD is called a twisted nematic (TN) display. Another type of LCD is called super twisted nematic (STN) display. Both types employ a nematic liquid crystal. A polymer alignment layer is applied to the conductive film on each substrate facing the nematic liquid crystal and is rubbed to create a series of parallel microscopic grooves in the surface of the film which are oriented in the same direction as the plane of polarisation of the polarising filter disposed on each substrate. These grooves ensure that the first layer of molecules of the liquid crystal are aligned with their longitudinal axes parallel to the grooves. Each successive layer of molecules gradually twists until the furthest layer is at an angle (90 degrees in twisted nematic displays) to the first layer and so that the outermost molecules contacting each substrate are matched with the plane of polarisation of the

polarisation filters on that substrate. The LCD also includes a sheet of reflective material on its back surface.

When there is no voltage applied between the conductive films, light striking one of the polarisation filters is polarised. The first layer of molecules then guides the light they receive to the next layer. When the polarised light reaches the end of the liquid crystal, it has been guided through an angle of 90 degrees and now passes through the second polarising filter and is subsequently reflected back off the reflective surface placed behind it. The reflected light is guided back through the crystal along the same path and emerges in the same place that it struck the polarisation filter. When an electric charge is applied to a region of the liquid crystal molecules, the orderly twisted arrangement of the molecules in that region is disrupted and the molecules untwist. This changes the angle of the light passing through them so that it no longer matches the angle of the polarising filter preventing the light from passing back out of that region of the LCD, making it darker than the surrounding areas. The region to which a voltage is applied is normally one or more of the character forming segments or pixels. By applying current to different character forming segments or pixels simultaneously, a recognisable character or numeral can be generated.

The polarising filter is formed from a chemical compound composed of molecules that naturally align in parallel relation to one another so that they create a microscopic filter that blocks any light not matching their alignment. The light passing through the polarising filter between the supporting layers is thereby polarised.

It is desirable to manufacture electronic displays which are as thin as possible so that they do not take up too much space in the housing of an electronic device in which they are used. For example, LCDs are found in mobile telephones and it is generally desirable to make a mobile telephone housing as small as the electronic components it contains will allow. If a LCD having a reduced thickness is used, a corresponding reduction in thickness of the mobile telephone housing can be realised or more space is made available for other components.

An exploded view of the main components of a prior art LCD 1 is illustrated in Figure 1 and it will be seen that it comprises a liquid crystal layer 2 sandwiched between a pair of plastic optically non-birefringent front and rear substrate layers 3a, 3b. A thin transparent film 4 of conductive material is applied to the back surface of front substrate layer 3a facing the liquid crystal layer 2 which is then etched to form character segments (not shown). A second transparent conductive film 6 is applied to the surface of the rear substrate 3b facing the liquid crystal layer 2. Each film 4,6 is treated with a polymer alignment layer (not shown) which is rubbed to form a series of parallel microscopic grooves. A polarising filter 7,8 is then positioned over each of the plastic substrate layers 3a, 3b with their planes of polarisation oriented at right angles to each other and so that the plane of polarisation of each filter corresponds to the grooves formed in its adjacent substrate. A pair of supporting layers 11a, 11b sandwich each polarising filter 7,8. A reflective layer 9 is also located on the back of the LCD behind polarising filter 8.

The total thickness of the LCD may be approximately 0.726mm. The liquid crystal layer 2 may be in the region of 0.006mm thick, and the plastic substrate 3a,3b on either side of it may be in the region of 0.1mm thick. Each polarising filter 7,8 and the two supporting layers 11a, 11b have a total thickness in the region of 0.26mm, each filter alone being approximately 0.1mm thick and each supporting layer 11a, 11b being 0.08mm thick.

The present invention seeks to provide an electronic display having a reduced thickness and which is cheaper and easier to manufacture.

According to the present invention, there is provided an electronic display comprising an active layer spaced from a polarising filter by a supporting layer which provides a common substrate for both the polarising filter and the active layer.

Preferably, the active layer and the polarising filter are in direct contact with the supporting layer.

In a preferred embodiment, the active layer is sandwiched between two polarising filters, the active layer being spaced from each polarising filter by a substrate layer which provides a common substrate for each polarising filter and the active layer.

The polarising filter is preferably a film and is formed from a chemical compound.

The or each supporting layer is/are conveniently constructed from plastic film.

Preferably, a conductive coating is applied to the surface of the or each supporting layer facing the active layer.

In another embodiment, a colour filter layer is disposed between the or each supporting layer and the active layer.

The electronic display of the invention is preferably a liquid crystal display of the twisted nematic or super twisted nematic types. Alternatively, the electronic display may be a light emitting polymer display, the active layer being a light emitting polymer layer, or an organic LED display, the active layer being formed from an organic LED material.

The present invention also provides a telecommunications device incorporating the electronic display according to the invention.

Preferably, the telecommunications device is a mobile telephone.

Although the present invention is described with reference to a twisted nematic display, it will be appreciated that the invention is also applicable to other types of LCDs including super twisted nematics (STN), dual scan twisted nematics, (DSTN), ferroelectric liquid crystal (FLC) and surface stabilized ferroelectric liquid crystal (SSFLC).

An embodiment of the present invention will now be described, by way of example only, with reference to Figures 2 to 5 of the accompanying drawings, in which:
Figure 1 shows an exploded view of a prior art LCD;
Figure 2 shows an exploded view of a liquid crystal display (LCD) according to the invention;
Figure 3 shows an exploded view of a light emitting polymer display (LEP) according to a second embodiment of the invention; and
Figure 4 shows an exploded view of an organic light emitting diode (LED) display according to a third embodiment of the invention.
Figure 5 shows a mobile telephone incorporating the electronic display shown in Figure 2, Figure 3 or Figure 4.

The prior art LCD has already been described above. Referring now to Figure 2, there is shown an LCD according to an embodiment of the invention which is similar to the LCD described with reference to the prior art LCD except that the plastic substrates 3a, 3b between the polarising filter support layer 11a and the liquid crystal layer 2 have been removed. The thin transparent conductive film layer 4 originally coating a surface of the substrate 3a and the thin transparent conductive film layer 6 originally coating a surface of the substrate 3b are now applied directly to the surface 12 of each support layer 11a facing the liquid crystal layer 2. A polymer alignment layer is applied directly to the surface 12 of each support layer 11a in the same way that it is applied to the substrate 3a, 3b of the prior art.

The LCD of the invention functions in exactly the same way as the prior art LCD described above. However, its thickness is reduced by the thickness of the substrates 3a,3b. In the description of a prior art LCD given above, the substrates were 0.1mm thick and the overall thickness of the LCD was 0.726mm. Therefore, the thickness of the LCD has been reduced by 0.2mm to 0.526mm which represents a thickness reduction of 25%. It is also cheaper to manufacture as the two optically non-birefringent plastic substrates 3a,3b are no longer required. A reflective layer 9 is provided on the surface of the supporting layer 11b disposed on polarising filter 8, as with the prior art LCD described above.

A second embodiment of the invention is illustrated in Figure 3, which shows a light emitting polymer display (LEP). The LEP display is identical to the LCD display illustrated in Figure 2 except that the active or liquid crystal layer 2 has been replaced with a light emitting polymer layer 13. Furthermore, the polarising filter 8, the supporting layer 11b and the reflector 9 are omitted.

A third embodiment of the invention is illustrated in Figure 4, which shows a organic light emitting diode display (LED). The LED display is identical to the LCD display illustrated in Figure 2 except that the active or crystal layer 2 has been replaced with an organic LED material layer 14. Furthermore, the polarising filter 8, the supporting layer 11b and the reflector 9 are omitted.

A mobile telephone incorporating the electronic display of the invention is illustrated in Figure 5. The telephone 15 has a front and rear face 16,17. The front face 16 is provided with a user interface having a keypad 18, a display 19 formed from the electronic display 1 of the invention, an ear piece 20, a microphone 21 and an on/off key 22. The telephone 15 may be adapted for communication via a wireless telecommunications network, e.g. a cellular network. However, the telephone 15 could also be designed for a cordless network. The keypad 18 has a first group of keys which are alphanumeric and by means of which a user can enter a telephone number, write a text message (SMS) or write a name associated with a particular number, etc.

The keypad 18 additionally includes two soft keys 23, the functionality of which depends on the state of the telephone and the navigation in the menu by means of a navigation key 24, and two call handling keys 25, which can be used for establishing a call or a conference call, terminating a call or rejecting an incoming call.

Many modifications and variations of the invention falling within the terms of the following claims will be apparent to those skilled in the art and the foregoing description should be regarded as a description of the preferred embodiments only. For example, the electronic display of the invention may be installed in apparatus other than a mobile telephone, such as a personal digital assistant (PDA).

Claims

1. An electronic display comprising an active layer spaced from a polarising filter by a supporting layer which provides a common substrate for both the polarising filter and the active layer.

2. An electronic display according to claim 1, wherein the active layer and the polarising filter are in direct contact with the supporting layer.

3. An electronic display according to claim 1 or claim 2, wherein the active layer is sandwiched between two polarising filters, the active layer being spaced from each polarising filter by a substrate layer which provides a common substrate for each polarising filter and the electronic display.

4. An electronic display according to any preceding claim, wherein the polarising filter is a chemical compound film.

5. An electronic display according to any preceding claim, wherein the or each supporting layer is/are constructed from plastic film.

6. An electronic display according to any preceding claim, wherein a conductive coating is applied to the surface of the or each supporting layer facing the active layer.

7. An electronic display according to any of claims 1 to 6, wherein a colour filter layer is disposed between the or each supporting layer and the active layer.

8. An electronic display according to any preceding claim, comprising a liquid crystal display, the active layer being a liquid crystal layer.

9. An electronic display according to any of claims 1 to 7, comprising a light emitting polymer display, the active layer being a light emitting polymer layer.

10. An electronic display according to any of claims 1 to 7, comprising an organic LED display, the active layer being formed from an organic LED material.

11. A telecommunications device incorporating the electronic display according to any of claims 1 to 10.

12. A telecommunications device according to claim 11, comprising a mobile telephone.

13. An electronic display substantially as hereinbefore described with reference to Figure 2 to 4 of the accompanying drawings.

14. A mobile telephone substantially as hereinbefore described with reference to Figure 5 of the accompanying drawings.

Application No: GB 0031124.1 9 **Examiner:** Jane Croucher
Claims searched: 1 to 14 **Date of search:** 11 July 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): G2F (FSX)

Int Cl (Ed.7): G02F (1/1335)

Other: Online: WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2119110 A	TEXAS INSTRUMENTS (see whole document, especially figure 2)	1, 2, 3, 4, 5, 6, 8
X	GB 2075211 A	NINTENDO (see whole document, especially figure 6)	1, 2, 3, 6, 8
X	GB 1485306 A	PETER WILD (see whole document)	1, 2, 3, 4, 6, 8
X	US 6151087 A	PHILLIPS (see abstract and figure 3A)	1, 2, 3, 4, 6, 8, 11, 12
X	US 4953952 A	SUMITOMO (see whole document)	1, 2, 3, 4, 6, 7, 8
X	US 4712873 A	KANBE (see whole document especially figure 3B)	1, 2, 3, 6, 8
X	JP 56162717 A (RICOH) published 14.12.1981 (see WPI abstract accession number 82-06958E/04, PAJ abstract, and figure 1)		1, 2, 3, 5, 6, 8

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.